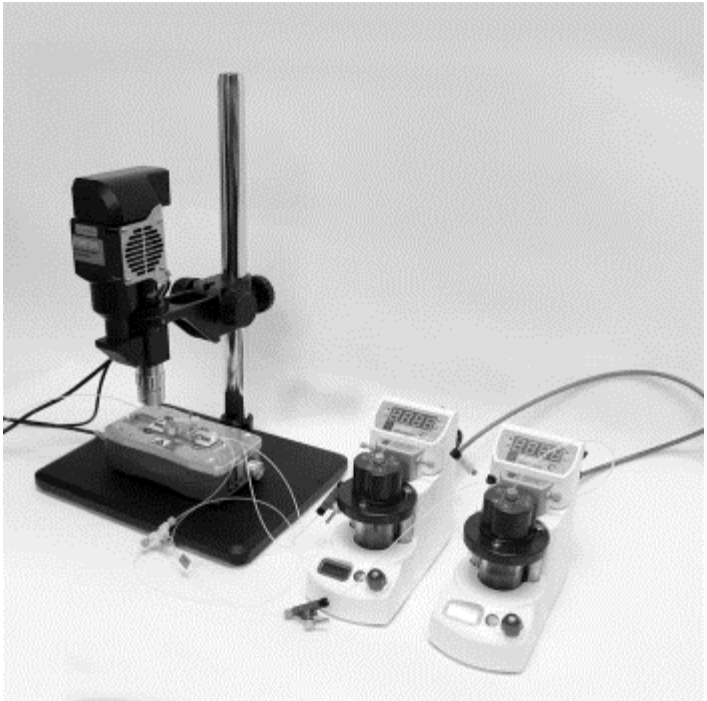

Setting up a Microfluidic System to Create Droplets

Dolomite

Version: **1.1**

Author: **AM**

Date: **13/12/2017**

P/N: **N/A**

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1 Introduction

This document will explain how to set-up a simple pressure pump system using good practices to you help to get the best from your investment.

This guide is aimed at researchers who are new to microfluidics or infrequent users who need a refresher.

2 Pre-requisites

Warning and safety information

- Where the equipment is situated is very important. The area must be free of dust so avoid positioning it near air vents, air conditioning units, ceiling fans or any equipment that blows out air.

- Avoid placing the equipment under shelving.

- The benching should be clean and free from vibration.

- All liquids used with your system (including cleaning solutions) must be filtered. We suggest using a 0.2µm filter.

- Powder free gloves should be worn at all times when handling any part of the system.

- Only lint-free cloths should be used to clean benches, equipment and chips.

- Air supply, whether site-wide, from a compressor or gas cylinder, should go through a dust filter before the pumps.

- Flow Control Centre software is only compatible on PC's with Windows 7.and Windows 10. It is not compatible with Windows 8.

- Read all the user guides relating to your equipment prior to use. If you do not have access to the user guides, you can download them from the Dolomite Microfluidics website. Click here to go to the downloads page.

3 System Set-up

Figure 1 below shows a typical system with 2 P-Pumps, Flow Sensors/Interface and a Microscope.

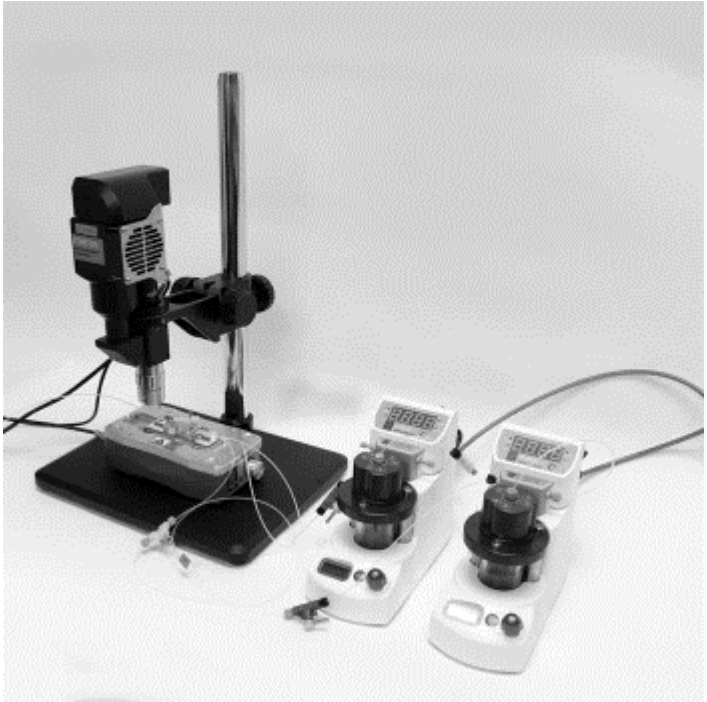


Figure 1

Ensure the surface where the Droplet System is to be used is free from dust and fibres. Wipe down with lint free wipes and a suitable surface cleaner. (2-Propanol is suitable for most surfaces).

3.1 Cutting Tubing

- Ensure the bench or cutting mat is free from dust and fibres.
- A PTFE tubing cutter (P/N 3000398) is the best option to make clean cut through tubing.
- Thread the tubing through the cutter taking care not to allow the tubing to drag along the blade. See figure 2.
- Cut to the desired length.
- The most commonly used tubing is 1/16" OD, 0.25mm ID (P/N 3200063)

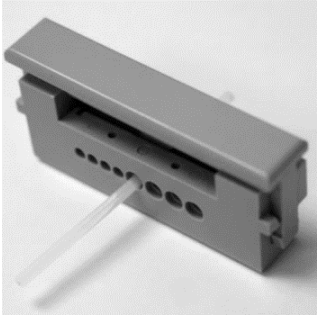


Figure 2

3.2 Assembly of the 4-Way Linear Connector

It is important that all ports in the connector have tubing or blanking plugs inserted. This is to allow the seal to maintain integrity and provide the best fluidic connection.

- Cut tubing to the required length.
- Remove the seal from the linear connector.
- With the tubing held away from the metal cleat, push each length of tubing through the PEEK part of the connector such that approximately 3mm of tubing goes beyond the connector. See **Error! Reference source not found.**.
- Push the tubing into the cleat to lock it in position. See **Error! Reference source not found.** and **Error! Reference source not found.**

Figure 5

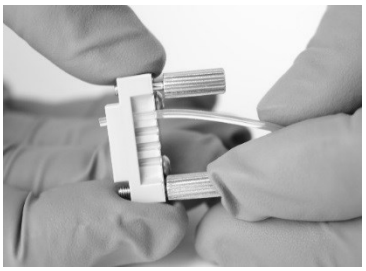


Figure 3

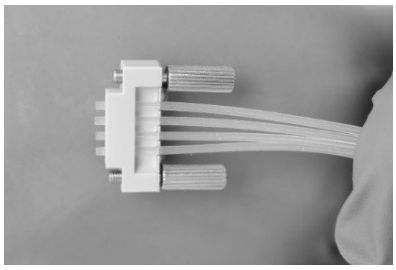


Figure 4

- Push the seal over the tubing ensuring that the tubing protrudes from the seal. See Figure 6.
- Lift the tubing out of the cleat.
- Push down on to a clean bench so that the tubing is flush with the seal and push the tubing into the cleats. See Figure 7 and Figure 8.
- Spare parts are available from the web shop; 4-Way linear Connector with seals (P/N 3000024), FFKM seal (P/N 3000061) and FKM seal (P/N 3200454).

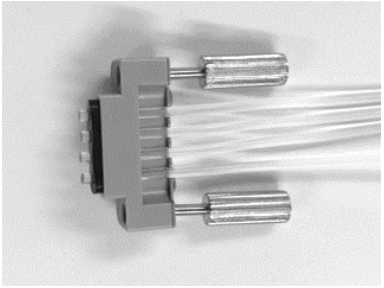


Figure 6

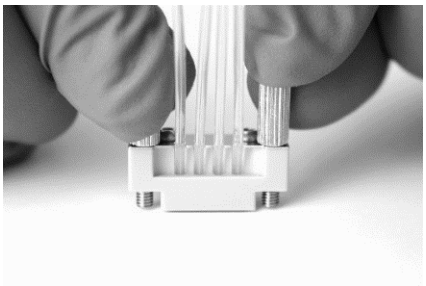


Figure 7

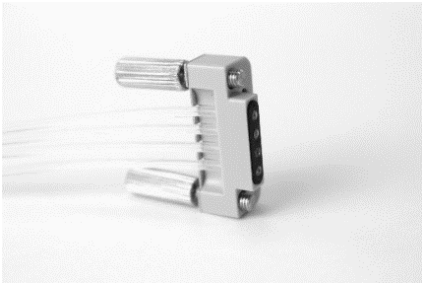


Figure 8

3.3 Assembly of the Chip, Interface and Connectors

- Orientate the chip in the interface, see Figure 11.
- We used a 190µm hydrophobic droplet junction chip (P/N 3000437.)
- Loosely attach both connector/tubing assemblies, see Figure 9.
- Gradually tighten diagonally opposite corners. Where the seal touches the edge of the chip, a colour change can be observed when the correct tightness is achieved. See Figure 10.
- Tighten each screw gradually and evenly. You must ensure that the connector is aligned with the chip and that each connector has the same gap between the connector and the H-Interface

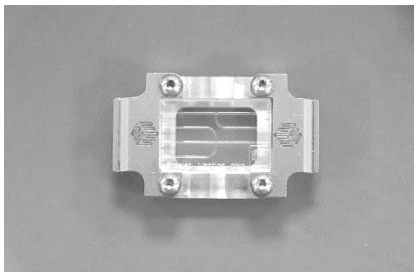


Figure 9

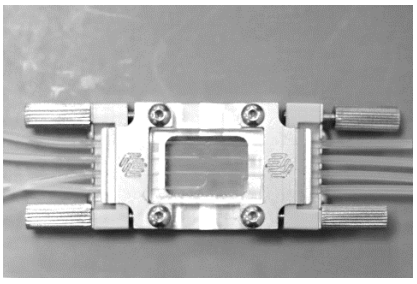


Figure 11

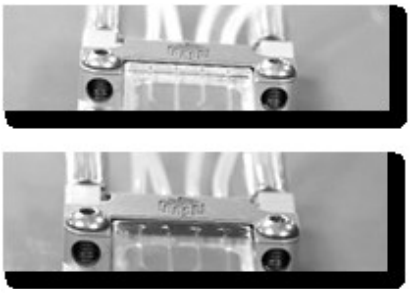


Figure 10

- The image in Figure 12 shows correctly fitted connectors and H-interface, Figure 13 shows incorrectly fitted connectors with a gap on the bottom left corner.

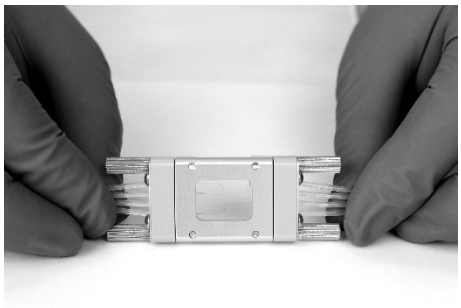


Figure 12

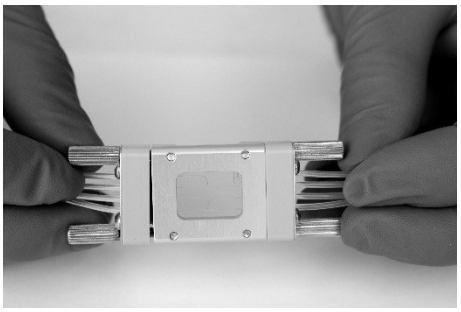


Figure 13

3.4 Making Fluidic Joints

Here we describe how to make a leak-proof fluidic joint with tubing, ferrules and compact fittings.

The following parts are required;

- Female to female straight fitting (P/N 3000399) Port plug (P/N 3000255) or solid tubing (P/N 3000056)
- 1.6mm OD, 0.25mm ID PTFE tubing (P/N 3200063) (or your own choice of 1.6mm OD tubing)
- ¼" Compact Fittings (P/N 3200059)
- 1.6mm Ferrules (P/N 3200060)
- Screw a port plug into the female to female adaptor, see Figure 14. If you don't have a port plug available, you can use a fitting, ferrule and a section of solid tubing instead.
- This can now be dedicated to make new fluidic joints, keep this "Joint Tool" handy for future use.
- Slide a ¼" fitting over the tubing.
- Slide a ferrule over the tubing so the flat face is flush with the tubing. You can do this pushing it down onto a clean, flat surface.
- Screw the Joint Tool firmly onto the new assembly and tighten firmly by hand but do not use any tools.
- Unscrew the Joint Tool from the new joint. The ferrule will now be gripped onto the tubing. If you find that the ferrule/tubing is stuck onto the fitting, use your finger nail (with a glove on!) separate the fitting and the ferrule.
- The ferrule should pop out still attached to the tubing. Then when you assemble your microfluidic system, the tubing won't coil up as the connection is tightened.

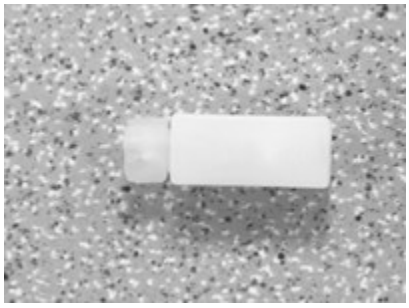


Figure 14

3.5 Connecting Flow Sensors, Interfaces and Displays

Whether a Flow Sensor Interface, (Figure 15), or a Flow Sensor Display, (Figure 16) is used, the principle of incorporating them into the system is the same. The flow sensors lock into place on the interface/display and then the assembly fits onto two locating posts on the top of the P-Pump fit on top of the P Pump.

Figure 15

Figure 17

Figure 16

- Push the sensor into the Display/Interface so it clicks into position, Figure 17.
- Place the assembled Display/Interface/Flow Sensor over the 2 locating pins on the top of the P-Pump.
- Thread the cone fitting over the tubing (0.8mm OD) supplied with the flow sensor.
- Push the tubing into the flow sensor until it comes to a dead stop.
- Holding the tubing in place, tighten the cone fitting so that it is a lightly firm fit. If it is too loose, the integrated ferrule will not grip the tubing. In this case, remake the joint so it is a little tighter.
- With the joint correctly made, a small amount of tubing will stick out of the fitting, Figure 18.
- Repeat for the other side.
- Replacement convertor kit is (P/N 3200285)

Figure 18

3.6 Connecting the Chip/interface Assembly to the P Pumps

We will assume that a 1-50ul minute flow sensor will be fitted to each pump. For higher flow rate sensors, simply exclude the convertors on each side of the flow sensor

Tubing is all 1/16" OD, 0.25mm ID

Recommended Tubing Lengths:

Section	Carrier Phase Pump	Droplet Phase Pump	Joint Type
Tubing through dip tube fitting	20cm	20cm	Plain cut tubing secured with dip-tube fitting
Dip tube to Female to Female (F2F)	-	-	Fitting and Ferrule
F2F to pre-made convertor	As supplied	As supplied	Pre-made joint
Convertor to flow sensor	-	-	Cone fitting on 0.8mm OD tubing
Flow sensor to convertor	-	-	Cone fitting on 0.8mm OD tubing
Pre-made convertor to F2F	As supplied	As supplied	Pre-made joint
F2F to 2-way valve	20cm	20cm	Fitting and Ferrule
2-way valve to chip	N/A	60cm	Fitting and Ferrule
2-way valve to T-Piece	20cm	N/A	Fitting and Ferrule
T-Piece to linear connector	2 x 20cm	N/A	Fitting and Ferrule
Linear connector	-	-	Plain cut tubing

3.7 Priming

- Using the liquids to be used to make droplets, prime both pumps at 3 bar for 20 seconds to remove air from the system and tubing.

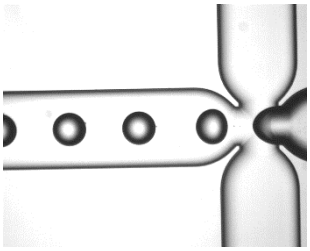
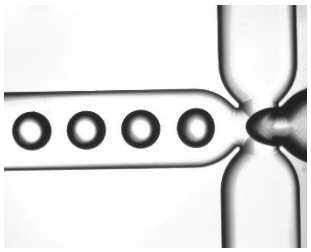
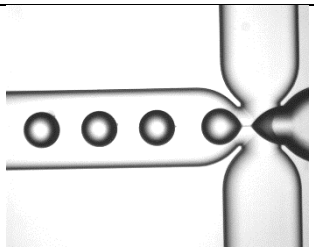
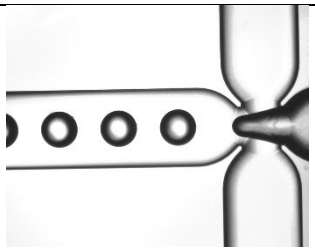
3.8 Making Droplets

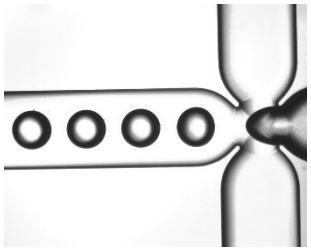
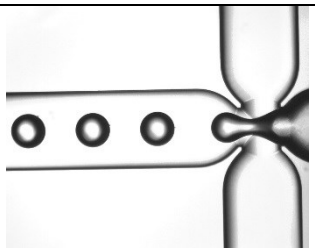
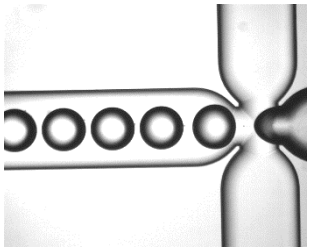
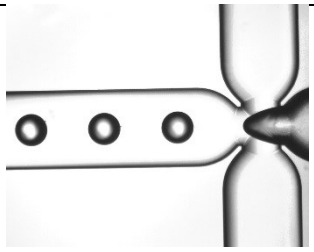
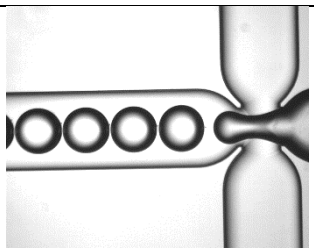
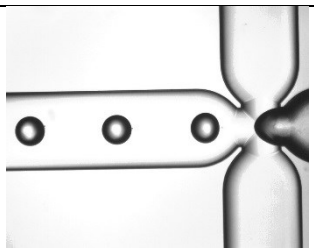
- Fit the chip into the interface and attach the linear connectors as described in section 3.3
- Fit the assembled chip and interface onto your microscope.
- Close the 2-way valve from both pumps.
- Switch both pumps on and open FCC.
- Prepare and filter (0.2um) water for the droplet phase and
- Prepare and filter (0.2um) mineral oil with 2% SPAN 80 for the carrier phase.
- Load liquids into the pumps.
- Turn on the supply pressure or compressor.
- Set the correct liquid class for each pump.
- In pressure control mode, set the carrier pump to 80mbar and the droplet pump to 800mbar.
- Open the 2-way valve for the carrier phase and allow to prime through the chip.
- Open the 2-way valve for the droplet phase, droplets will now be produced.
- Once you have droplets of the correct size and frequency, change to flow control made. This

will automatically adjust for changes in laboratory conditions that can affect droplet monodispersity e.g. the effect of temperature on viscosity

- To stop making droplets ensure both pumps are in pressure control mode. Close the 2-way valve for the droplet phase then close the 2-way valve for the carrier phase.
- Stop the pumps in FCC.
- By varying the ratio of droplet to carrier, the size and frequency of the droplets can be altered.
- To increase the size of the droplet, increase the droplet phase pressure/flow or decrease the carrier phase pressure/flow.
- To decrease the size of the droplet, decrease the droplet phase pressure/flow or increase the carrier phase pressure/flow.
- To increase the frequency of droplets, increase the pressure/flow to both pumps.
- To decrease the frequency of droplets, decrease the pressure/flow to both pumps.
- If you wish to balance the pressure of both pumps, you will need to change the flow resistance. For this set up, on the droplet pump, you could use 0.1mm ID tubing and/or, increase the length of the tubing.

The table below shows the effect of changing the ratios of the pumps.

Droplet Phase mbar	**Fixed Carrier Phase 800mbar**	**Carrier Phase mbar**	**Fixed Droplet Phase 100mbar**
80		800	
90		900	

110		1000	
130		1100	
150		1200	

4 Useful References

The Dolomite Microfluidics Website has extensive information such as application notes, microfluidics calculator, user guides and FAQ's. The latest version of FCC can also be downloaded from the website.

Visit: www.dolomite-microfluidics.com

If you have any further questions, contact support at support@blacktrace.com

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For the quickest response for all technical enquiries please email support@dolomite-microfluidics.com

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